Workshop Without Walls: Upstairs Downstairs

Breakout Group 1 Note-taking

Debate #3:

what context is required to distinguish between biotic and abiotic O2?

If you are thinking about a planet in the HZ, with an ocean - we could look at glint (glancing angle of sunlight).
We need a spectral window to access this reflectance. Unlike the case of Venus - which is covered heavily with clouds.
You want to be able to determine surface temperature - to nail the presence of liquid water. How to distinguish between water and another liquid - surface temperature at the right regime.
How polarised is the glint going to be? Polarization observations can help!
How instrumentally hard is it to detect glint? Required monitoring planetary brightness in specific filters - we have to think about what bands the filters should cover. (0.4 - 2um a possibility)
Mars has very little water vapor in the atmosphere. We know it was volcanically active in the past.
Water is co-trapped in the poles in the earth's atmosphere.
Stellar activity will matter in the evolution of the atmosphere - might influence in the buildups of O2 in atmosphere.
4.3 um is the wavelength of the dimer collision. If you don't have background gas as N2, then water vapor likely to be bulk gas - with higher concentration in the upper atmosphere and largely be photolyzed - pathological
You might be likely to boil the ocean first - not lose N2 first and be left with water behind in the atmosphere.
When O2 comes from photodissociation, 10-100s times more O2 likely in the atmosphere (Wordsworth et al?)
If you want to look at the pressure in the atmosphere (misra et al) - to observe collision induced absorption lines. Is there any other way to get pressure of dimers ? - No one has thought of any other way.
If you saw 100s of bars of O2 in the atmosphere - likely due to a massive runaway. And likely life does not exist!
How can you create such high pressure of O2? At the star evolves - eventually gets brighter the HZ moves in, and this initiates runaway.
At such pressures - life would spontaneously combust :) .
In diamond anvil cell experiments in high pressures, living cells seem to exist!

Near subduction zones, life can live at high pressures. Life seems more to be dictated by a thermal limit rather than a pressure limit.

How to explain the lack of O_2 in venus' atmosphere - explained as runaway and got dragged down in solid phase.Planets can be in runaway for many Myr.

F and G stars are the best host stars to look for inhabited planets. M stars are the low mass stars - then the K stars larger in mass. Sun is a G type star. M stars are interesting because: 1) accounts for 75% of observed stars. 2) live (main sequence) for 1000s of Myr. 3) planet star radius contrast is more. Have deeper transits and more easily observable. M stars are redder. HZ are much closer to the stars. Highly active - Mstars - flares are common events.
Mstar - atmosphere - atmosphere produced by photolysis of water.
Relative abundances of different elements from different line strengths - tricky
You cant model Earth's atmosphere without considering the minor constituents.

David Catling and others - their models have albedos dependent on wavelength. 1 bar - 10 bars of CO_2 - significant starlight still reaches the surfaces. At higher pressures, less.

Another thing to look for in the spectrum is CO - which is an indicator of an abiotic process - CO can be considered as an anti-biosignature.

If it is volcanically active, the planet can get rid of abiotic O_2.

Consider an Enceladus like planet - where no surfacial water but water vapor is still being added into the atmosphere.